Integrating vaccinomics, precision vaccinology, and computational science into TPP-driven vaccine development

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France Vaccins is a large R&D initiative aiming at boosting the vaccine development capacity of French public institutes and hospitals. By bridging the gap between preclinical research and clinical validation, it delivers decisive support to operational response capabilities in the perspective of emerging infectious disease outbreaks. This translation from TRL 4 to 7 is generally considered as a high-risk phase which might require major organizational, operational, and cultural changes, in addition to novel collaborative frames with Industry.

Vaccine development is undergoing a paradigm shift, driven by advances in vaccinomics, precision medicine, and computational sciences. These innovations offer unprecedented opportunities to tailor vaccines to specific populations, enhance immunogenicity, and accelerate the development pipeline. We will discuss how the Target Product Profile (TPP) approach, a strategic framework defining the desired characteristics of a vaccine candidate, can be significantly enriched by integrating these cutting-edge disciplines.

The next-generation of vaccines should not only be effective and safe but also tailored to the needs of global populations, including most vulnerable populations such as older adults or those affected by chronic and immune compromising medical conditions which have borne a disproportionate burden of morbidity and mortality during outbreak. Characterizing vaccine responses in such populations presents unique challenges due to under-vaccination, sub-optimal vaccine responses, and distinct mechanisms of vaccine-induced protection. Multi-disciplinary strategies and international collaborations would be instrumental for innovative biomarkers, bioassays, and combination regimen in this field.